Light scattering by dense discrete random media of small particles: exact and approximate numerical solutions

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Electromagnetic scattering and absorption in a macroscopic particulate medium composed of densely-packed microscopic particles constitute an open computational problem. This results in the absence of quantitative inverse methods to interpret various spectroscopic, photometric, and polarimetric remote sensing observations.

In this talk, we will discuss the applicability of the exact and approximate numerical methods to model scattering and absorption by dense discrete random media. The exact numerical methods such as the superposition T-matrix, integral-equation, and finite-difference methods, give rise to the full wave numerical solution [1]. The required computation time, however, limits the size of the entire random medium and prevents the analysis of macroscopic medium consisting of billions of particles. The approximate methods, for example the radiative transfer and coherent backscattering (RT–CB), can address large media but the accuracy of the solution is questionable, particularly for the systems of close-packed particles. Recently, a numerical technique has been developed for the dense discrete random media of spherical particles entitled as the radiative transfer with reciprocal transactions R2T2 [2,3]. By comparing the exact and approximate solutions, we show that the R2T2 and its extension to non-spherical particles can be applied for the microscopic as well as the macroscopic dense discrete random media. Further, we discuss the approximations of the R2T2 that allow for efficient spectroscopic, photometric, and polarimetric analyses of planetary regolith.

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References

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